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ABSTRACT

The Technology Advisory Committee of the National Council of Teachers of Mathematics recently conducted a survey to assess the status of state-level policies affecting the use of calculators and computers in the teaching of mathematics in grades K-12. The committee determined that state-level actions related to the increased availability of calculators and computers in the public schools are affecting the definition, delivery, and evaluation of K-12 mathematics in about half of the states. Due to the limited empowerment of many state educational agencies to actively promote curricular change, most actions have taken the form of model curriculum outlines, teaching guidelines, consultation, and information dissemination. A small number of states have: (1) sponsored teacher inservice on the instructional applications of computers; (2) proposed the revision of certification standards for teachers of mathematics in order to ensure teacher competency in the use of calculators and computers in teaching mathematics; (3) mandated the use of calculators on statewide testing of secondary students; or (4) encouraged the use of calculators in instruction and testing. The use of calculators during classroom instruction is supported by 40 percent of the states. (PK)

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TECHNOLOGY POLICY SURVEY:

A Study of State Policies Supporting the Use of Calculators and Computers in the Study of Precollege Mathematics

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

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conducted by

Bob Kansky
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at the request of

The Technology Advisory Committee
National Council of Teachers of Mathematics

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TECHNOLOGY POLICY SURVEY

Bob Kansky, Texas A&M University

The Technology Advisory Committee of the National Council of Teachers of Mathematics recently conducted a survey to assess the status of state-level policies affecting the use of calculators and computers in the teaching of mathematics in grades K-12. Prior to this study, there was no national data available regarding the actions taken by state educational agencies to support the use of calculators and computers as tools of precollege mathematics instruction.

LOCUS OF CONTROL

The principal purpose of the survey reported here was to ascertain the role being played by state educational agencies in promoting a specific instructional issue. Inasmuch as there is a danger that the results may be interpreted as a measure of the intent of state-level leadership regarding that issue, there is a need to preface the reporting of survey outcomes with an observation regarding interstate variability in the policy-making power of state educational agencies.

A study conducted by Wirt (1978) documented a wide range in the degree to which statewide educational agencies share control of educational policy making (and enforcement) with local educational agencies. At one end of the spectrum, Wirt identified state agencies which at that time had almost complete control of all issues related to the certification of teachers, the definition of curricular goals, and the selection of instructional materials. At the opposite end of the spectrum were local educational agencies which retained control over most issues related to curriculum and materials. Although there currently is a trend toward increased state-level control of educational policy, responses to this survey made it clear that the extent to which that control is shared with local agencies still varies widely from state to state. Hence, the reader should be mindful that state-level activity in developing and implementing policies regarding the use of technology in the teaching and testing of precollege mathematics is, to a considerable degree, a function of the mandated role of the state educational agency with respect to the formation and monitoring of policies governing precollege education. Moreover, the general rule is that state agencies are empowered to recommend or assist with curricular innovations rather than to mandate them.

INSTRUMENT AND SAMPLE

A single-sheet questionnaire (Attachment 1) was sent to one representative in each of 56 'states' having membership

in the Association of State Supervisors of Mathematics (ASSM). In addition to the 50 United States, ASSM members include five Canadian provinces and the District of Columbia. The questionnaire was designed to gather data related to five questions.

1. To what extent have the states prescribed (through state-level mandates, rules, or regulations) the purchase or use of calculators for the purposes of teaching and testing precollege mathematics?

2. To what extent have the states recommended (through nonbinding state-level guidelines) the purchase or use of calculators for the purposes of teaching and testing precollege mathematics?

3. What state-level actions are being taken to produce legislation, guidelines, or implementation suggestions regarding the use of calculator/computer technology in defining the content and sequencing of precollege mathematics?

4. What state-level actions are being taken to produce legislation, guidelines, or implemention suggestions regarding the use of calculator/computer technology in modifying techniques of instruction in precollege mathematics?

5. What is the status of state-level efforts to adopt specific standards regarding the certification of precollege teachers of computer science and/or information systems?

The survey form, accompanied by a explanatory memorandum from TAC and a supporting memorandum from the president of ASSM, was sent to representatives of 56 state educational agencies in August 1986. Completed questionnaires were received from 55 states. A list of respondents is given in Attachment 2.

RESULTS

Responses to each of the items of the questionnaire were encoded on a simple data summary sheet. That sheet (Attachment 3) affords an overall view of the status of state-level policy development relative to the issues addressed. Supplemented and qualified by the comments and documents provided by the respondents, it is the foundation of the observations which follow.

State Mandates Regarding Calculators

Few states have mandated the purchase or use of calculators for the purposes of teaching or testing precollege mathematics. Three of the 55 states now prescribe the use of calculators on statewide mathematics achievement tests for grade seven and above; a fourth state has this same policy under consideration. Only one of these states currently is planning to extend the use of calculators to testing at the elementary school level. (It is interesting to note that one of the states not prescribing the use of calculators on statewide testing of precollege students has proposed that prospective teachers be permitted to use calculators when taking the mathematics achievement test required for certification.) In all cases, the tests involved have been modified to include sets of items for which the use of a calculator is appropriate.

Five states have policies which call for the use of calculators as a part of classroom instruction in grades 7 and above; two of these prescribe the instructional use of calculators at the elementary school level. Curiously, only one of the states which has mandated use of the calculator on statewide secondary school mathematics tests also has mandated its use in classrooms at that level.

Only one state reported the allocation of monies for the statewide purchase of calculators. The machines purchased will be made available in eighth grade classrooms because their use is prescribed on the statewide mastery test for grade 8. The use of calculators for instruction at that level is recommended but not required.

State Recommendations Regarding Calculators

Sixty-four percent of the respondents reported that their states are preparing (4 states) or have published (31 states) written guidelines which suggest the use of calculators in precollege mathematics instruction. Of 31 states recommending the use of calculators during mathematics instruction throughout grades K-12, there are 12 which propose that calculators also be used during classroom testing. The guidelines of four states suggest limiting the use of calculators to secondary school mathematics instruction (with three states including classroom testing as a component of instruction); two recommend the use of calculators for instruction (excluding testing) at the elementary school level only.

State-level recommendations regarding the purchase of classroom sets of calculators are included in the guidelines

of only six states. Three of these states propose that calculators be made available to all students at all levels of instruction (grades K-12), whereas three states call for the availability of calculators at the secondary school level (grades 7-12) only.

Actions Regarding Curricular Content and Sequencing

Twenty-three (42%) of the responding states are working on or have produced guidelines or model curricula to aid the integration of calculators and computers into mathematics instruction. Although two states have restricted their work to grades 7-12, the typical effort is directed toward proposing the use of calculators and computers to deliver mathematics instruction or to explore/solve mathematics problems in grades K-12. Instructional emphasis appears to be upon the use of these devices as tools of study rather than as objects of study. With rare exception, this integration involves the mathematics programs of all students irrespective of ability levels or postsecondary education plans.

A few states have introduced new secondary school "computer mathematics" courses which focus upon the application of computers to the solving of problems in mathematics. Also, two states reported the addition of discrete mathematics "strands" to the secondary school curriculum.

Actions Regarding Modifying Instructional Techniques

Thirty-three states reported no state-level activity aimed at examining the implications of calculators and computers with respect to techniques of instruction in precollege mathematics. Of these, three-fourths were among the 32 states which reported no state-level actions regarding changes in the content and sequencing of the precollege mathematics curriculum.

The 22 states taking action regarding techniques of instruction are employing one or more of three procedures: (a) dissemination of information about instructional materials or techniques associated with the use of calculators and computers, (b) presentation of inservice programs which examine exemplary technology-related instructional materials and discuss the use of such materials in classroom instruction, and (c) revision of teacher certification standards to call for preparation in the uses of calculators and computers in teaching mathematics. Wherever such efforts have been made, the

target population has been all teachers of mathematics (grades K-12).

The first of these three procedures is the most common, being used by 13 of the 22 states. The materials disseminated include written guidelines for using calculators/computers in mathematics teaching and, specifically, documents which match items of computerized courseware to instructional elements of the mathematics curriculum. And while some states simply disseminate information about inservice programs, four states sponsor such programs directly and/or cooperate with professional groups in conducting the programs.

Certification Standards in Computing

Nearly half (49%) of the repondents reported that their states have not adopted standards specific to the certification/endorsement/accreditation of precollege teachers of computer science or information systems; they also indicated that their states currently have no plans to develop such standards. It now is left to the local school districts to select persons to staff courses in the area. The usual procedure appears to be to appoint teachers who are certificated in another subject (e.g., business, mathematics, or science) and who volunteer to teach courses in computing. The operable criterion appears to be "interested, experienced, and appropriately educated." Respondents' comments warrant the observation that the need for state-level certification/endorsement/accreditation standards for teachers of computing presently are not perceived as a need in these states. Two states have had proposed standards rejected; several proferred the opinion that it will be "some time" before such standards would be needed or appropriate.

Of the 14 states having adopted standards, half provide only for an endorsement to an existing certificate and four have grandfather clauses to accommodate those persons already teaching computing courses. (Another 14 states have plans to develop standards at least at this level.) The typical endorsement standard calls for 12 semester hours of coursework of which half must be in at least one high-level language; also, at least one course in the application of computers to instruction is specified. The typical certification standard of 24 hours of coursework includes 12 hours of computer science courses and 12 hours of coursework in instruction computing or "related topics." Certification standards of only two states require a course in methods of teaching computing -- that is, a course having the objective of providing teachers with ideas and techniques for teaching

topics in computing. In two states, it has been left to the universities to each define appropriate programs of preparation for computing teachers.

SUMMARY

State-level actions related to the increased availability of calculators and computers in the public schools are affecting the definition, delivery, and evaluation of K-12 mathematics in about half of the states. Owing to the limited empowerment of many state educational agencies to actively promote curricular change, most actions have taken the form of model curriculum outlines, teaching guidelines, consultation, and information dissemination. A small number of states have sponsored teacher inservice on the instructional applications of computers, have proposed revision of certification standards for teachers of mathematics in order to ensure teacher competency in the use of calculators and computers in teaching mathematics, have mandated the use of calculators on statewide testing of secondary school students, or have encouraged the use of calculators in classroom instruction and testing. Surprisingly, the use of calculators during classroom instruction in K-12 mathematics is supported by 40 percent of the states.

Although half of the states reported efforts to create standards for the certification/endorsement/accreditation of teachers of computer science (or information systems), their actions do not appear to accept computing as a unique instructional area. The typical plan is to add this teaching area to the certificate of persons holding primary certification in other subjects. The proposed programs suggest that 8-24 hours of coursework -- half of which would be in computing literacy, instructional computing, or related subjects -- would constitute an adequate knowledge base. (Where teacher competency in specific languages is noted, the languages named are BASIC, Logo, and Pascal.) Given the existence of grandfather clauses in some of those standards, the majority of the states currently "certify" teachers of computing who have not participated in an organized educational program specific to that field.

References

Wirt, F. M. (1978). What state laws say about local control. Phi Delta Kappan, 59(8), 517-520.

TECHNOLOGY POLICY SURVEY QUESTIONNAIRE

The purpose of this survey is to obtain information regarding state-level policies on selected technology issues. Realizing that such policies are new or under development, we ask that you give a "best description" of your current situation. Specifically, please

*** provide the three items of identification requested,
*** provide status information by checking the appropriate boxes in the items which follow,
*** PROVIDE COPIES OF SUPPORTING DOCUMENTS (or references to the sources of such documents) wherever possible, and
*** make comments or qualifying remarks wherever appropriate.

****

IDENTIFICATION INFORMATION

Your name: _____ Phone: (____)____-_____
District/Province/State/Territory: _____
****

POLICY ISSUE 1: AVAILABILITY OF CALCULATORS

1. a) Put an 'X' in the box next to each situation for which calculator availability is prescribed by state-level mandate, rule, or regulation.

[] During mathematics instruction in elementary school classrooms
[] During mathematics instruction in junior high school classrooms
[] During mathematics instruction in senior high school classrooms
[] While taking mathematics tests in elementary school classrooms
[] While taking mathematics tests in junior high school classrooms
[] While taking mathematics tests in senior high school classrooms
[] While taking state-mandated achievement tests in mathematics

b) Are there currently efforts under way to establish state-level mandates, rules, or regulations relative to the availability of calculators in any of the situations listed in Item 1? If so, please describe them.

_____
_____

2. a) Put an 'X' in the box next to each situation for which calculator availability has been recommended through state-level written guidelines (although not prescribed by mandate, rule, or regulation).

[] During mathematics instruction in elementary school classrooms
[] During mathematics instruction in junior high school classrooms
[] During mathematics instruction in senior high school classrooms
[] While taking mathematics tests in elementary school classrooms
[] While taking mathematics tests in junior high school classrooms
[] While taking mathematics tests in senior high school classrooms
[] While taking state-mandated achievement tests in mathematics

b) Are there currently efforts under way to prepare written state-level guidelines relative to the availability of calculators in any of the situations listed in Item 3? If so, please describe them.

_____
_____

3. Is there a state-level mandate, rule, or regulation which prescribes the purchase of classroom sets of calculators?

[] Yes [] No

If so, to what levels does that mandate, rule, or regulation apply?

Grade levels _____

4. Are there written state-level guidelines which recommend the purchase of classroom sets of calculators (although such purchase is not prescribed by mandate, rule, or regulation)?

[] Yes [] No

If so, to what levels do those guidelines apply?

Grade levels _____

POLICY ISSUE 2: CERTIFICATION STANDARDS IN COMPUTING

5. Place an 'X' in the box next to the statement which describes your current state-level situation with respect to the adoption of specific standards governing the certification of precollege teachers of computer science and/or information systems.

[] Certification standards have been adopted. (Please enclose a copy or indicate how one might be obtained.)

[] Certification standards are being prepared but have not yet been adopted.

[] No specific certification standards have been considered to date. (If this is the case, please note how a school might staff courses in computer science and/or information systems.)

_____

_____

POLICY ISSUE 3: TECHNOLOGY-RELATED CURRICULUM REVISION

6. Has the increasing availability of calculator/computer technology resulted in state-level planning to produce legislation, guidelines, or suggestions regarding the implications of those technologies with respect to the content and sequencing of the precollege mathematics curriculum?

[] Yes [] No

If so, please note what has been (or is being) done and/or indicate how additional information might be obtained.

_____

_____

7. Has the increasing availability of calculator/computer technology resulted in state-level planning to produce legislation, guidelines, or suggestions regarding the implications of those technologies with respect to techniques of instruction in precollege mathematics?

[] Yes [] No

If so, please note what has been (or is being) done and/or indicate how additional information might be obtained.

_____

_____

Attachment 2

TECHNOLOGY POLICY QUESTIONNAIRE RESPONDENTS

STATE	RESPONDENT	TELEPHONE
Alabama	Linda Pledger	205/261-2757
Alaska	Peggy Cowan	907/465-2841
Arizona	Kay Dean	602/255-5233
Arkansas	Charles Watson	501/371-2941
California	Joe Hoffmann	916/323-6151
Colorado	Christine Comins	303/564-3136
Connecticut	Steve Leinwand	203/566-2645
Delaware	Bill Geppert	302/736-4885
District of Columbia	Gordon Lewis	202/576-7816
Florida	Andy Reeves	904/488-1701
Georgia	Eloise T. Barron	404/656-2685
Hawaii	Kathleen Nishimura	808/395-8916
Idaho	Tom Farley	208/334-2281
Illinois	Wendell Meeks	217/782-2826
Indiana	Martha Wilson-Hegg	317/927-0111
Iowa	Barbara Wickless	515/281-3253
Kansas	Anne Auman	913/296-2598
Kentucky	Sheila Vice	502/564-2672
Louisiana	Jean Reddy Clement	504/342-3417
Maine	Jacqueline Mitchell	207/299-5925
Manitoba	Peter Luba	204/269-1007
Maryland	June Danaher	301/659-2313
Massachusetts	Susan S. Foote	617/641-3710
Michigan	Charles R. Allan	517/373-1024
Minnesota	Richard Clark	612/296-4070
Mississippi	Dollie S. Mosley	601/359-3872
Missouri	Vena M. Long	314/751-4445
Montana	Dan Dolan	404/444-4436
Nebraska	Chuck Friesen	402/473-0264
Nevada	Ron Gutzman	702/885-3136
New Hampshire	Fernand Prevost	603/271-2632
New Jersey	Barbara A. Nuding	609/984-1456
New Mexico	Hilde Howden	505/842-3731
New York	Fred Paul	518/474-3900
North Carolina	Cleo Meek	919/733-3602
North Dakota	Charles DeRemer	701/224-2514
Nova Scotia	Rita Guilfoyle	902/424-4258
Ohio	Steve Meiring	614/466-1792
Oklahoma	Susan Gay	405/521-3361
Ontario	Robert J. Stevenson	519/472-1440
Oregon	Don Fineran	503/378-3778
Pennsylvania	Frank Reardon	717/787-3499
Rhode Island	Jim Harrington	401/277-2821
Saskatchewan	Frank Bellamy	306/787-6084
South Carolina	Bill Hynds	803/734-8369
South Dakota	Marilyn Hala	605/773-4689
Tennessee	Karen Hanna	615/741-7856
Texas	Cathy Peavler	512/463-9585
Utah	Donald Clark	801/533-6040
Vermont	Bob Kenney	802/828-3111
Virginia	Edgar Edwards, Jr.	804/225-2063
Washington	Elden Egbers	206/753-6747
West Virginia	Ernestine Capehart	304/348-7805
Wisconsin	Donald Chambers	608/266-7712
Wyoming	Bill Futrell	307/777-6247

DATA FROM TECHNOLOGY POLICY SURVEY

	Questionnaire Item Number						
	1	2	3	4	5	6	7
STATE	CALC USE MANDATES	CALC USE RECOMMEN-DATIONS	CALC PURCHASE MANDATES	CALC PURCHASE RECOMMEN-DATIONS	CS CERTI-FICATION	PLAN CON-TENT CHANGE	PLAN IN-STRUC-TIONAL CHANGE
AL	---	ECD	---	---	-C-	EC-	-C-
AK	-C-	EC-	---	---	---	EC-	---
AZ	-C-	PC	---	EC-	-C-	EC-	EC-
AR	---	EC-	---	---	PC-	PC-	-C-
CA	E--	EC-	---	---	ECD	EC-	EC-
CO	---	E--	---	---	-C-	---	---
CT	ECD	ECD	EC-	EC-	---	ECD	-C-
DE	---	E--	---	---	P--	---	E--
DC	---	EC-	---	---	ECD	ECD	EC-
FL	---	--D	---	---	P--	---	---
GA	---	E--	---	---	---	---	---
HI	---	E--	---	---	---	EC-	EC-
ID	---	-C-	---	---	---	---	---
IL	-C-	E--	---	---	P--	---	---
IN	---	PC-	---	---	-C-	EC-	EC-
IA	---	EC-	---	---	P--	-C-	PC-
KS	PC-	---	---	---	EC-	---	---
KY	---	-CD	---	---	PCD	E-D	P-D
LA	---	---	---	---	E-D	E-D	PC-
ME	---	---	---	---	-C-	---	---
MD	---	---	---	---	P--	---	---
MB	---	EC-	---	---	-C-	---	---
MA	-C-	-C-	---	---	-C-	---	-C-
MI	PC-	PC-	---	---	P--	EC-	PC-
MN	---	---	---	-C-	---	---	---
MS	---	---	---	---	PC-	---	---
MO	EC-	EC-	---	EC-	P--	EC-	EC-
MT	-C-	-CD	---	---	-C-	-C-	EC-
NE	---	---	---	---	PC-	EC-	EC-
NV	---	E-D	---	---	P-D	---	---
NH	---	---	---	---	-C-	---	---
NJ	---	EC-	---	---	-C-	---	PC-
NM	---	---	---	---	---	PC-	---
NY	---	EC-	---	---	-C-	EC-	EC-
NC	-C-	-C-	-C-	---	E-D	---	---
ND	---	E--	---	---	EC-	---	EC-
NS	EC-	PC-	---	EC-	-C-	EC-	EC-
OH	---	EC-	---	---	EC-	---	-C-
OK	---	E-D	---	---	E-D	---	---
ON	EC-	EC-	---	---	EC-	-C-	EC-
OR	---	E--	---	---	---	EC-	---
PA	---	---	---	---	-C-	---	---
RI	---	-C-	---	---	---	-C-	EC-
SK	---	EC-	---	---	ECD	PC-	PC-
SC	---	---	---	---	-C-	---	---
SD	-C-	EC-	---	---	E-D	---	---
TN	---	EC-	---	---	-C-	---	---
TX	E--	EC-	---	---	EC-	EC-	-C-
UT	E--	E--	---	E--	P--	EC-	EC-
VT	---	E--	---	---	E-D	ECD	ECD
VA	---	EC-	---	---	-C-	-C-	EC-
WA	---	EC-	---	---	P--	---	EC-
WV	---	---	---	---	-C-	-C-	---
WI	---	ECD	---	---	ECD	ECD	---
WY	---	---	---	---	P--	---	---

KEY TO SYMBOLS USED IN THIS CHART:

Each district/province/state is listed in alphabetical order according to the full spelling of its name (rather than according to its two-letter postal symbol).

Table entries use the following symbols to indicate the general nature of the response made to each of the questionnaire items.

- E: the object of inquiry presently exists
- P: the object of inquiry is in preparation
- -: no action has been take relative to the object of inquiry
- C: comments were made by the respondent
- D: documentation was provided by the respondent